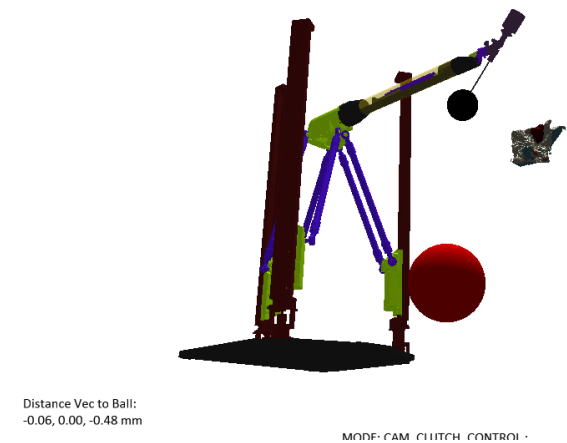
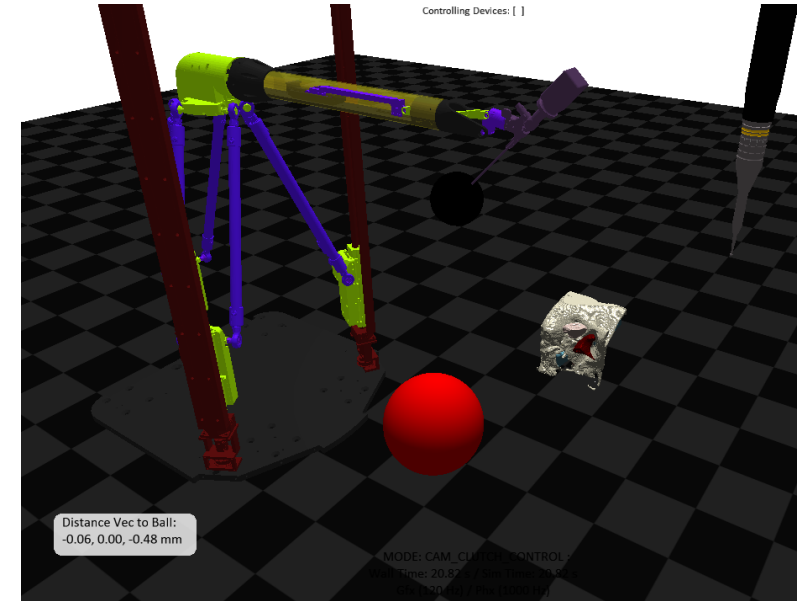


Friday Update 03-11-2022

Tommy Liang, Mike Fan, Jintan Zhang

Simulator Updates

- Issues:
 - Galen model STL files is off-scale
 - Order of ADF loading
- Updates:
 - Pipeline seems to work correctly, wrong numbers due to scaling
 - Swapping drill + rack with the 35-degree endoscope mesh



System Updates

- We have combined all pieces of the system, both directions working.
- Force calculation appears to be correct based on readings.
- More testing needs to be done, but Galen is experiencing issues at the moment.

Payload: Distance vector from TOOL TIP to
closest voxel on virtual surface d

1. Force applied to tool tip

$$d = (x, y, z, 0, 0, 0)$$

If $\|d\| > \alpha$, $d = (0, 0, 0, 0, 0, 0)$ where α is a
maximum

$F_{s_tip} = (1/\|d\|) * k_p * (\text{normalized}(d)) +$
[possible kd term] <- this is in robot frame

$$F_{s_ee} = Ad_{tip_ee}^T * F_{s_tip}$$

2. Resolve Force Vector at End Effector and Sum

$$F_{total} = w_1 * F_{s_ee} + w_2 * F_{handle}$$

w1 and w2 are adjustable weights

3. F_{total} get shipped to the optimizer

Next Steps

- Test combined system
- Draft an IRB and send draft to Pete

Galen Side Update

High Level Controller

1. Update simulator joint state based on sent joint state from robot.
2. Higher level controller determines payload to send back to the Galen System based on the simulator location and constraints.

Payload: Force/Distance Vector indicating proximity to nearest sensitive tissue voxel

AMBF Plugin: ROS interface, Model State Update

Payload: Robot Joint State

Galen Force Behavior Mode

1. Follow standard Galen force control pipeline.
2. **Resolve Payload From simulator**
3. Solve for desired joint displacement by minimizing an $AX+B$ problem in optimizer.
4. Send desired joint displacements to actuators